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SHORT DENTAL IMPLANTS AS AN ALTERNATIVE TO LONG AND STANDERD DENTAL IMPLANTS IN CONJUGATION WITH MAXILLARY SINUS AUGMENTATION PROCEDURE: A SYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT

Long dental implants and standard dental implants are difficult to place in posterior part of maxilla because of reduced bone volume due to post extraction resorption of bone and Pneumatization of maxilla. So, aim of the present review to evaluate the success of short dental implants compare to long and standard dental implants in conjugation with maxillary sinus augmentation. Electronic search is carried out through PubMed, Google Scholar from year 2012 – 2022, highlighting the use of short dental implants and long dental implants in combination with sinus augmentation. The search yielded 174 titles. Finally, six Randomized controlled studies that fulfilled the inclusion criteria were included. All studies have a low risk of bias. Meta-analysis revealed significant differences regarding biological complications. No significant differences were found regarding other included outcome measures. Short dental implants can be used as an alternative to long and standard length implants in conjugation with sinus augmentation.

KEYWORDS: Atrophic Maxilla, Short Dental Implants, Sinus Augmentation, Short and Long Dental Implants

BACKGROUND

Standard and long dental implants with sinus augmentation are treatment of choice in the posterior maxillary area because of reduced bone volume and poor bone quality. However, it is associated with increase in the risk of surgical complications, morbidity of donor site, unpredictable resorption of graft material, increase in cost and time consumption. To overcome the problem associated with these short dental implants are developed. Therefore, we have made an attempt to determine and evaluate short dental implants versus long and standard length dental implants in conjugation with sinus augmentation.

MATERIALS AND METHODS

Study Selection Criteria

Inclusion criteria were as follows

1. Study specific to short and long dental implants in maxilla
2. Detail data on implant length and diameter
3. Criteria on implant failure clearly defined
4. Implant survival rates were either clearly indicated or calculable from data reported in the paper or as percentage basis
5. Follow up of at least one year after prosthetic loading
6. English language
7. Combination of long dental implants with sinus augmentation.
8. Randomized controlled studies only.

Exclusion criteria were as follows

1. Studies that didn't performed sinus augmentation
2. Review papers, Animals studies, in vitro study, Case reports, Case series, Case control studies.
3. Studies that didn't provide sufficient data on primary outcome measures.
4. Studies done on augmentation and short implant placement on mandible that didn't separate data regarding maxilla and mandible.

Broad inclusion criteria were adopted to render the findings of this review more general, without distinguishing patient characteristics, implant type, surgical technique, or prosthetic rehabilitations.

Search Strategy

Electronic search was carried out through PUBMED, GOOGLE SCHOLAR, from year 2012-2022 by using key words "Short dental implants", "sinus augmentation", "posterior or atrophic maxilla", "short and long dental implants".

Articles included in this study were taken from following journals:

Clinical Oral Implant Research, International Journal of implant dentistry, European journal of oral Implantology Clinical Implant Dentistry and Related Research, Journal of Periodontology, Journal of Clinical Periodontology, and International Journal of Periodontics and Restorative Dentistry, and International Journal of oral implantology, clinical implant dentistry and related research journal,

The review looks on certain key aspects of short implants and sinus augmentation that will be helpful in deciding whether to use or not when they are really indicated. Thus, the data obtained from each article was divided into 2 tables:

Study Selection
The titles of the identified articles were initially screened. The abstracts were assessed, when the abstracts indicated that the study fulfilled the inclusion criteria. Full-text analysis was done, when full text analysis fulfilled primary criteria, articles had included (Figure 1).

Outcome Measures
Outcome measures were as follows:

1. **Implant Survival and Failure:**
   This refers to the presence of an implant. Failure was defined as removal of the implant or loss of implant. Implants present with infection, mobile implants, Implants with progressive bone loss were indication of implant failure.

2. **Peri-Implant Marginal Bone Level (MBL)**
   The marginal bone levels were determined as the distance from the implant shoulder/collar to the most coronal point of bone-to-implant contact on the mesial and distal side of the implant.

3. **Clinical Parameters**
   This include probing pocket depth (PPD), bleeding on probing (BOP), plaque index (PI)

4. **Biological And Technical Complications**
   Biological complication refers to presence of intra operative and post operative complications (Bleeding, Swelling, Sinusitis, pain). Technical complications refers to fracture of abutment screw, screw loosening, chipping of veneering ceramic, lost crown, lost of retention and de-cementation.

Data Extraction
One reviewer extracted data using data extraction tables (Table 1 and Table 2).

Number of patients, number of implants, type of surgery, type of bone graft used, method of sinus Augmentations, residual bone height and width, type of prosthesis, follow up period, dropout rate, success rate, failure rate biological and technical complications.

Quality Appraisal
The selected studies were screened for quality assessment. In the randomized controlled trials, the risk-of-bias was assessed by the Cochrane Collaboration tool (Figure 2, Figure 3).

DATA ANALYSIS
The mean follow-up of the selected reports was calculated as the weighted mean on the number of implants investigated at each stage of the study. Data were presented at the implant level.

Primary outcome measures were meta-analyzed according to random effects models. Statistical heterogeneity was assessed by means of the I^2 statistic. We reported random-effects model results according to the test of heterogeneity. All the analyses were performed with Revman software .

RESULT
Biological Complications-Random Model
SIX studies with 455 randomized participants, reported on effect of short dental implants and long dental implants in conjugation with maxillary sinus augmentation. Results from all of these studies (except that by Bechara et al and Nielson et al) in this outcome showed no difference in GS and GG group. Study by Bechara et al, and Nielson et al favoured GS.
Overall, pooled data showed evidence in favour of GS: MD =0.15; 95% CI 0.03 to 0.70; p=0.02 (Figure 4).

Failure Rate
SIX studies with 455 randomized participants, reported on effect of short dental implants and long dental implants in conjugation with maxillary sinus augmentation. Results from all of these outcomes showed no differences regarding failure rate.

Overall, pooled data showed as non significant: MD =1.01; 95% CI 0.23 to 4.52; p=0.99 (Figure 5).

Technical Complications
SIX studies with 455 randomized participants, reported the effect of short dental implants and long dental implants in conjugation with maxillary sinus augmentation. Results from all of these outcomes showed no differences in terms of technical complications.

Overall, pooled data showed as non significant: MD =0.91; 95% CI 0.50 to 1.64; p=0.75 (Figure 6).

Periimplant Bone Level
SIX studies with 455 randomized participants, reported on the effect of short dental implants, long and standard length dental implants in conjugation with maxillary sinus augmentation. Results from all of these outcomes showed no differences with respect to technical complication.

Overall, pooled data showed as non significant: MD =0.03; 95% CI -0.05 to 0.12; p=0.40 (Figure 7).

Random sequence generation was performed in all studies and these studies were subjected to qualitative evaluation for the risk of bias (Figure 2).

DISSCUSSION
The aim of present systematic review is to Compare and evaluate short dental implants versus long and standard length dental implants in conjugation with sinus augmentation with the mean observation period of 5 years. The survival of implants, failure rate, peri-implant bone level, clinical parameters, biological and technical complications were primary outcome measures of study. Six studies with low risk of bias fulfilled the inclusion criteria.

Meta analysis of failure rate revealed no statistically significant

differences with values of p=0.99, 95%CI 0.23-4.52 and MD=1.01.Short dental implants can be used in posterior maxillary region as an alternative to long and standard length implants in conjugation with sinus augmentation procedure with equal rate of survival.

Result showed statistically significant differences with respect to biological complications (P=0.02, MD=0.15 and 95%CL of 0.03-0.07). Study by Bechara et al and Nielson et al favoured GS with complication of 19 and 11 respectively in GG. Therefore, less number of biological complications were associated with short dental implant placement.

Statistical analysis revealed no significant differences regarding Technical complications (MD =0.91; 95% CI 0.50 to 1.64; p=0.75).More number of technical complications were associated with long and standard length implants in conjugation with sinus augmentation

No statistical significant differences were reported in the analysis of peri-implant marginal bone level (MD =0.03; 95% CI -0.05 to 0.12; p=0.40).MBL range from -0.12±0.54 to 0.89±0.25 in group short and -0.18±0.96 to 1.08±0.29 in group graft. More amount of bone loss is associated with long and standard length group with augmentation procedure.

The limitation of this study is that it has included only RCT studies, only studies with augmentation procedure and no statistical analysis of bone dimensions and clinical parameters.

CONCLUSION

In conclusion short dental implants can be use as an alternative treatment choice to long and standard length implants in conjugation with maxillary sinus augmentation procedure. Using short implants reduces biological and technical complication, duration of treatment and cost.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

ACKNOWLEDGEMENTS

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Table 1: Details regarding the no. of patients, implant used and their dimension, residual bone dimensions, type of surgery and restoration for short dental implants compare to long and standard length dental implants in conjugation with maxillary sinus augmentation

Author	Year	No. of The Patients	Age/ Gender	Total No of Implants	Total No of Short Dental Implants And Their Dimensions	Total No of Long Dental Implants And Their Dimensions	Residual Bone Volume		Type of Surgery	Sinus Augmentation	Bone Graft Used	Number of Implants for Type of Restoration	Type of Implants
							Height	Width					
Thoma et al	2018	101	50.5 years / 49 men, 52 women	137	67 (6mm) L=6mm D=4mm	70 (≥11mm) L=11,13, 15mm D=4mm	5-7mm	≥6mm	Two stage (38) One stage (99)	Lateral window tech	Xeno-graft+ Auto-graft	Single crown= 70 FPD= 67	(Astra Tech implant system osseospeed EV 4.0S)
Nielsen at al	2021	40	Mean 52years/ 17 men, 23 women	37	20 (6*4.2mm)	17 (13*4.2mm)	>5.5mm	<8mm	Two stage	Lateral augmen-tation	Auto-graft+ xeno-graft	Single crown= 37	Chemically modified micro thread (Astra Tech implant system osseospeed EV 4.2S)

Taschieri et al	2017	52	51.75 years/30 women, 22 men	123	65 (≤8.5mm) L=6.5, 7.5, 8.5mm D=3.75-5mm	58 (≥10mm) L=10, 11.5, 13mm D=3.75-5mm	4-7mm	ND	Two stage	Lateral window tech	Xeno-graft (Bio-Oss)	Single crown= 13 FPD= 110	Sandblast-ed(Interna universal platform)
Bechara et al	2016	53	48 year/19 men,34 women	90	45 (6mm) L=6mm D=4-8mm	45 (≥10mm) L=10, 11.5, 13, 15mm D=4-8mm	≥4mm	≥5mm	Two stage(-bone crest level)	Lateral window tech	Xeno-graft (Osteo-Bi-ol)	single crown= 45 FPD=45	Tapered design with strong self cutting threads(Any Ridge im-plant Mega Gen implant)
Gulje et al	2019	38	49 years/18 men,20 women	40	21 (6*4mm)	20 (11*4mm)	6-8mm	≥6mm	Two stage	Lateral window tech	Xeno-graft+ Auto-log-ous	Single crown= 41	(Astra Tech implant system osseospeed EV 4.0S)
Pistilli et al	2017	20	56 years/8 men,12 women	34	**10 (5mm)** 6 (6mm) D=5,6mm L=5,6	18 (10mm) D=5,6mm L=10, 11.5, 13	5-7mm	≥7mm	Two stage	Crestal sinus lift and augmen-tation	Xeno-graft	Single crown= 34	External hex implants(X-FOS5/6xx-,Zimmer Biomet) (NXFOS-5/6xx, Zimmer Biomet)

FPD, fixed partial denture, L: lenght of implant, D: diameter of implant

Table 2: Implant survival rate and primary outcome measure of short dental implants compare to long and standard length dental implants in conjugation with maxillary sinus augmentation

Author	Year	Peri Implant Bone Loss	Biological Complications	Technical Complications	Clinical Parameters		Failure Rate	Follow Up	Implant Sur-vival Rate
					GS	GG			
Thoma et al	2018	-0.12±0.54 (GS) -0.18±0.96 (GG)	5 (GS) 9(GG)	21 (GS) 14 (GG)	PI= 13.6% PPD= 3 BOP= 40.9%	PI= 6.5% PPD= 3 BOP= 50%	N=1 (GS) N=0 (GG)	5 years	98.5% (GS) 100% (GG)
Nielsen et al	2021	0.60 (0.17) (GS) 0.51 (0.14) (GG)	0 (GS) 11(GG)	2 (GS) 6 (GG)	PI= 1.32 PPD= 2.4 BOP%=24	PI= 1.36 PPD= 2.5 BOP%= 22	N= 0 N= 0	1 year	100% (GS) 100% (GG)
Taschieri et al	2017	-0.91±1.22 (Mesial) (GS) -0.94±1.43 (Distal) (GS) -1.15±0.68 (Mesial) (GG) -1.06±0.70 (Distal) (GG)	0(GS) 0(GG)	0(GS) 0(GG)	PI= 5.5% BOP= 2.70% PPD= ND	PI= 3.77% BOP= 0% PPD= ND	N= 0 N= 0	3 years	100% (GS) 100% (GG)
Bechara et al	2016	0.201 (GS) 0.273 (GG)	0 (GS) 19 (GG)	0(GS) 0(GG)	ND	ND	N= 0 (GS) N= 2 (GG)	3 years	100% (GS) 95.6% (GG)
Gulje et al	2019	0.12±0.36 (GS) 0.14±0.63 (GG)	4(GS) 9(GG) *peri mucositis	4(GS) 1(GG)	PI=0 PPD=2.8 BOP=0	PI= 0 PPD= 3.3 BOP= 0	N= 1 (GS) N= 0 (GG)	5 year	94.7%(GS) 100%(GG)
Gastaldi et al	2017	0.89 (0.25) (GS) 1.08 (0.29) (GG)	0(GS) 1(GG)	1(GS) 0(GG)	ND	ND	N=0 (GS) N=0 (GG)	3 year	100% (GS) 100% (GG)

GS: short implant group, GG: long implants with graft, PI: plaque index, PPD: probing pocket depth, BOP: bleeding on probing , ND: no data available,

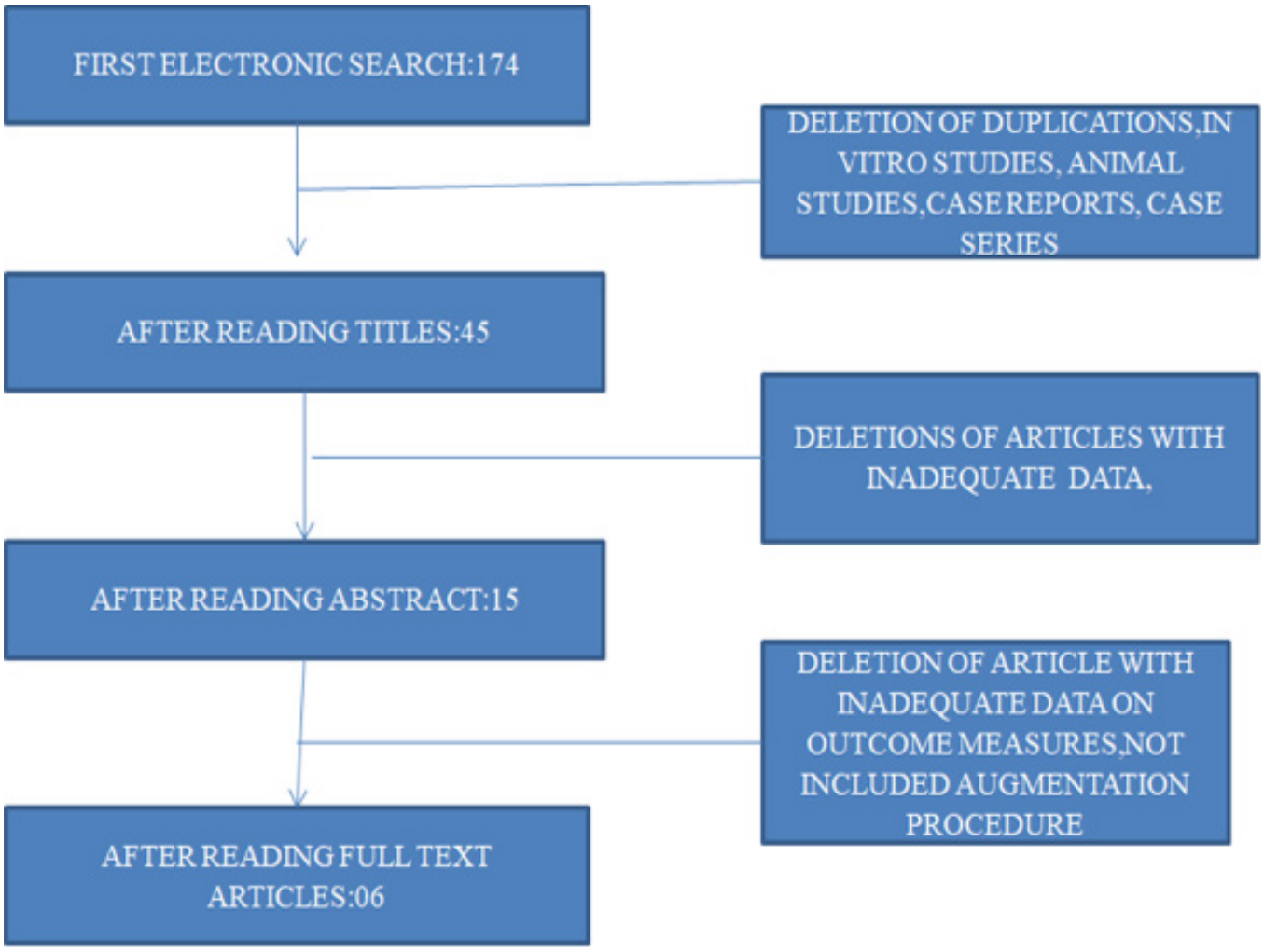

Figure 1: Prisma diagram of review

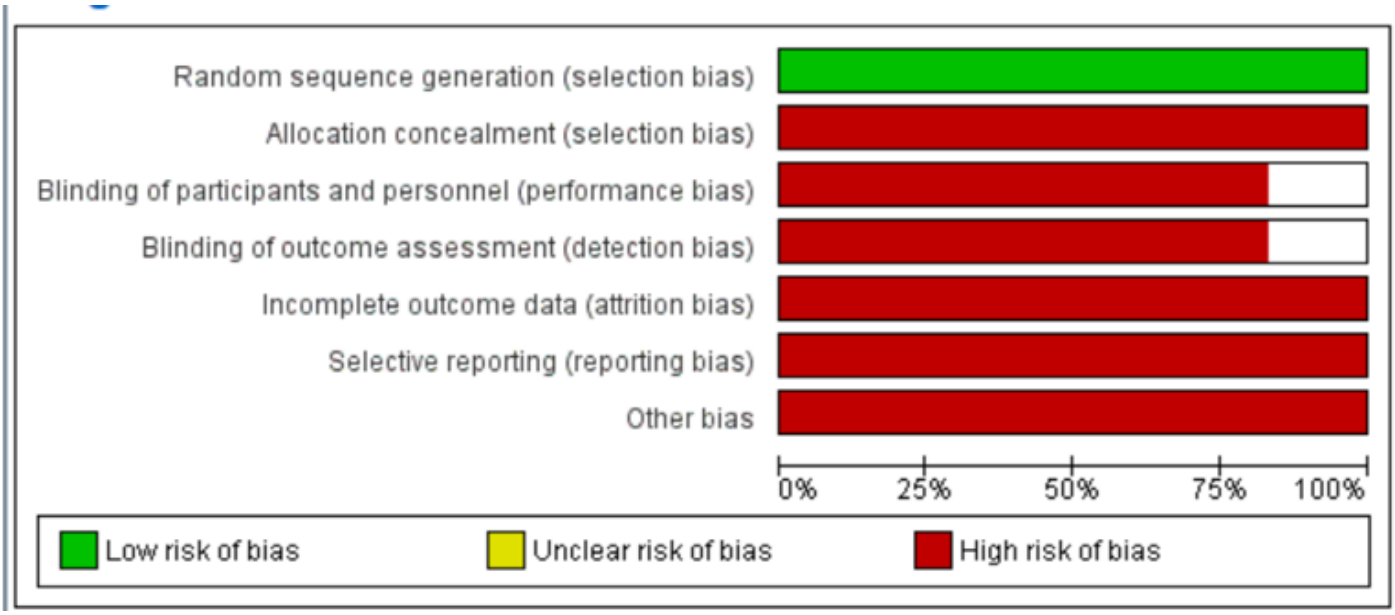

Figure 2: Qualitative evaluation for the risk of bias

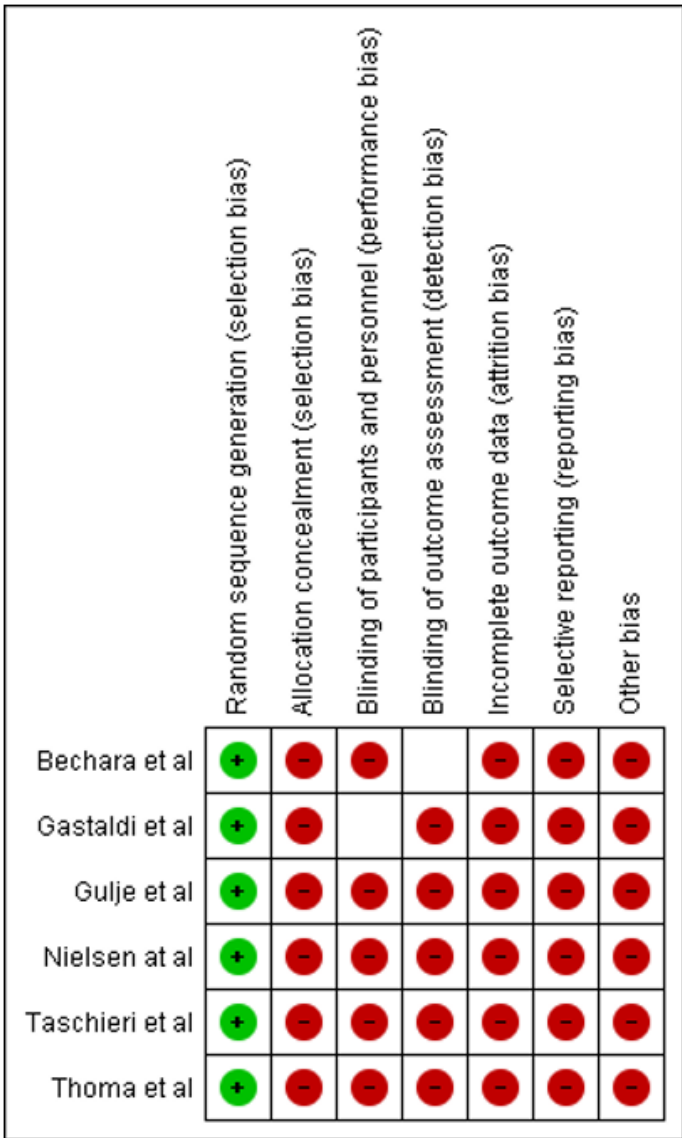

Figure 3: Risk of bias summary

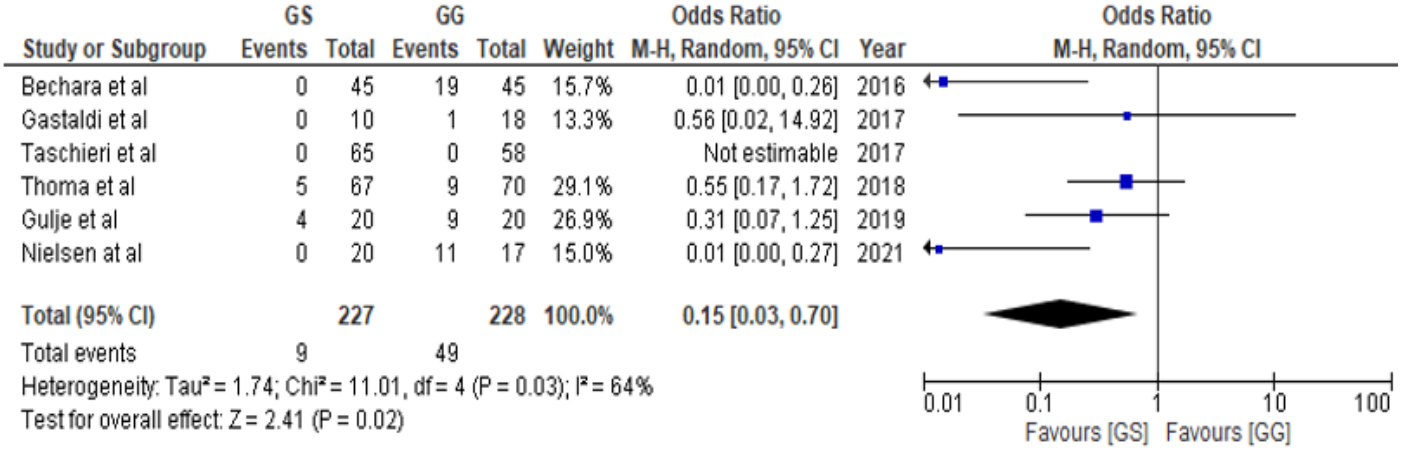

Figure 4: Biological Complications-Random model

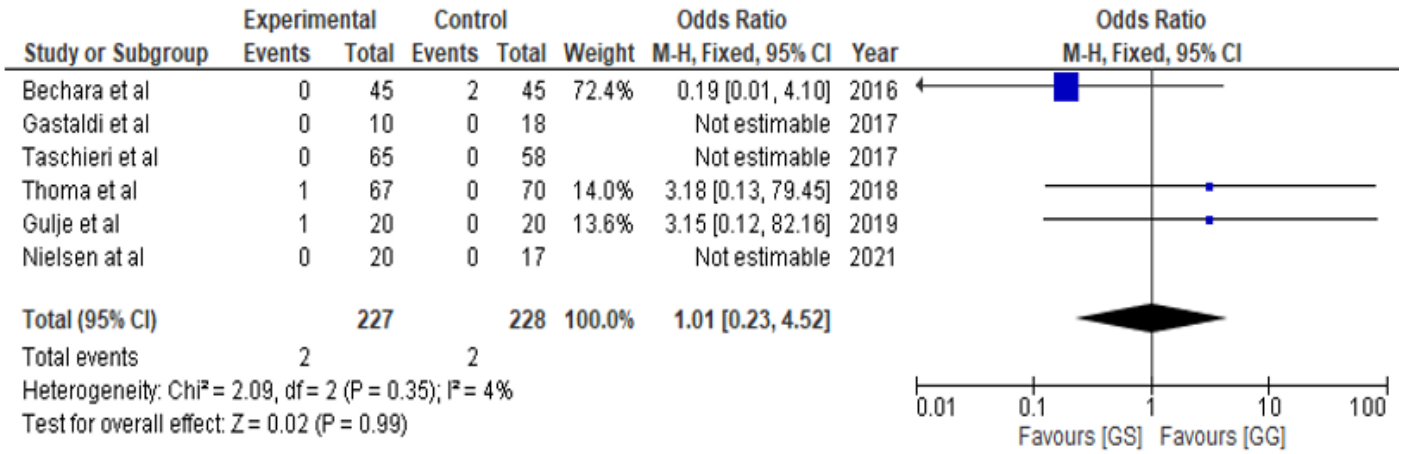

Figure 5: Failure rate

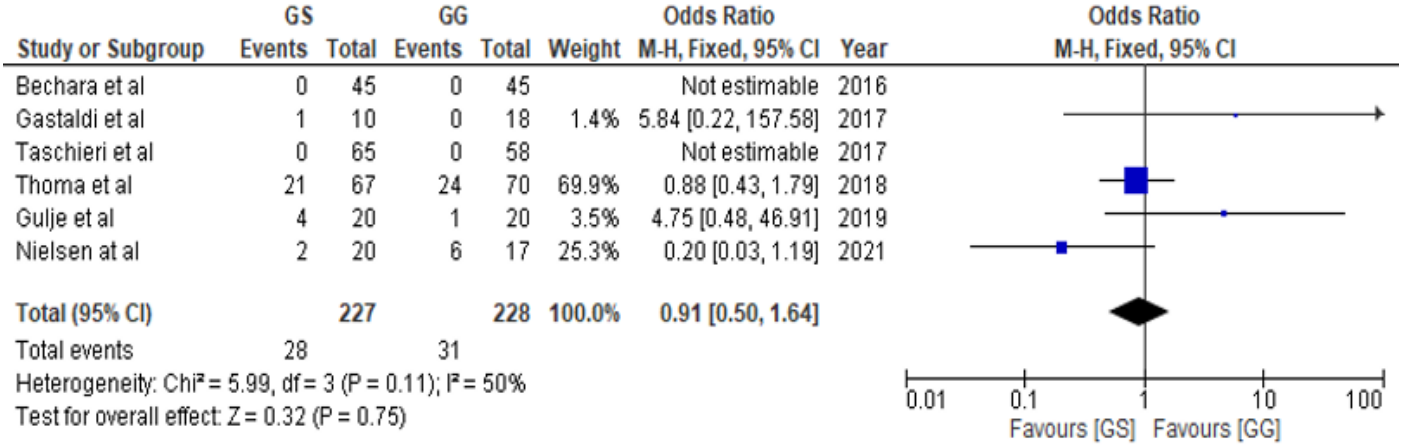

Figure 6: Technical Complications

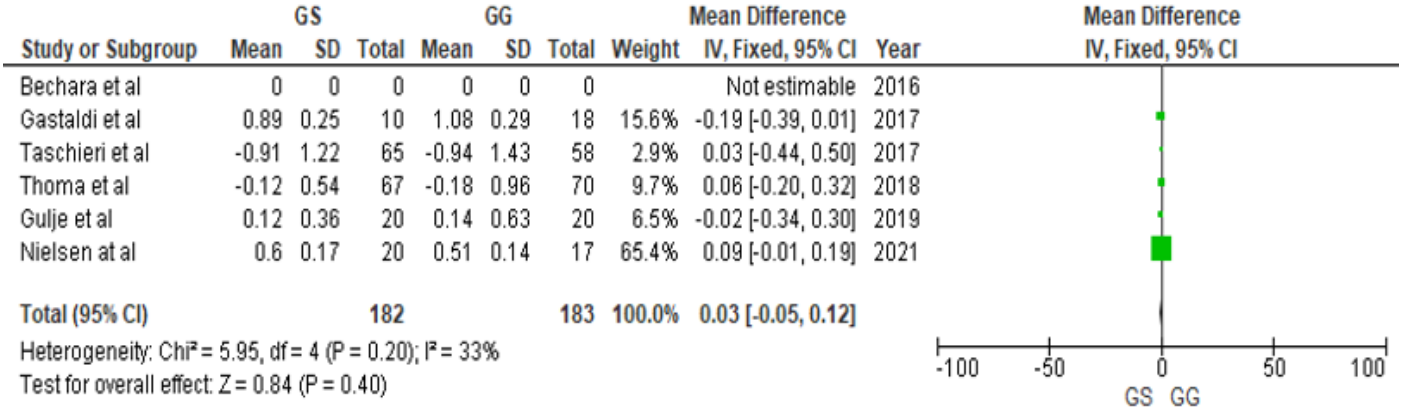

Figure 7: Peri-implant bone level